

27 October 1936

NRL Report No. B-1325

NAVY DEPARTMENT
BUREAU OF ENGINEERING

FR 1325

Report of Test
on
Transformers, Gun-Firing
submitted by
Allis Chalmers Company
Pittsburgh, Pa.

NAVAL RESEARCH LABORATORY
ANACOSTIA STATION
WASHINGTON, D. C.

Number of Pages: Text - 6 Plates - 2
Authorization: BuEng let.S62-2/L5(9-2-Ds) of 3 Sept.1936.
Date of Test: September and October, 1936.
Tested by: J. S. Bryant, Sr.Eng.Aide
Prepared by: W. B. Roberts, Pr.Eng.Aide
Chief of Section
Reviewed by: J. A. McNally, Lieut. U.S.N.
Approved by: H. M. Cooley, Captain, U.S.N.
Director
Distribution: BuEng (5)

LP

APPROVED FOR PUBLIC
RELEASE - DISTRIBUTION
UNLIMITED

Table of Contents

Authorization	Page 1
Object of Test	1
Abstract of Test	1
Conclusions	1a
Recommendations	1c
Description of Material	2
Method of Test	2
Results of Test	3
Conclusions	6

Appendices

Photograph of transformers as submitted	Plate 1
Photograph of transformers, case covers removed	2

AUTHORIZATION

1. This test was authorized by reference (a); another reference pertinent to this problem is listed as reference (b).

Reference: (a) BuEng let.S62-2/L5(9-2-Ds) of 3 Sept.1936.
(b) Specifications 17T19b, Transformers,
Electric (Below 750 watts) dated 1 May 1935.

OBJECT OF TEST

2. The object of this test was to determine how closely the subject transformers complied with the specifications, reference (b), and their suitability for the Naval Service as gun firing transformers.

ABSTRACT OF TEST

3. The subject transformers, sizes 100 V.A. and 200 V.A., were set up at this Laboratory in suitable test circuits, and their performance was carefully noted to ascertain whether they were in strict accordance with the specifications, reference (b). The usual inspection of the subject material, relative to materials, design, workmanship and a test for check integrity, concluded the test.

Conclusions

(a) The subject transformers, under test for conformance with the specifications, reference (b), failed to comply with the following requirements.

- (1) The secondary voltages of the transformers are 17.6 volts for the 100 V.A., and 17.2 volts for the 200 V.A., at rated loads and 115 volts impressed across each primary. The specifications require a secondary voltage of 18 volts under these conditions.
- (2) The total weight of the 100 V.A. transformer is 15 lbs. 9 oz. and 19 lbs. 1 oz. for the 200 V.A. transformer. The maximum allowable weight is 15 lbs.
- (3) Although two (2) bosses are provided on the inside of each case for the transformer mounting screws, they are not considered sufficient to insure a stable and rugged mounting for the transformer unit. The brass securing screws extend into holes in the bosses and not into threaded steel inserts, as required by the specifications.
- (4) Under test for shock integrity, the transformers when placed on a Bureau of Engineering shock stand in the vertical plane, six inches below point of impact, and given shocks of 250 foot pounds, the brass screws, securing the transformers to the case, partly backed out upon the application of each blow. Had sufficient bosses with threaded steel inserts been provided for the securing screws as required, the transformer units no doubt would have remained stable.
- (5) Under inspection of the transformers, relative to materials and workmanship, it was observed that the outer edges of the core laminations of the 200 V.A. unit have been filed or ground in order to fit the transformer into the case. The filing of these laminations defeats the purpose of insulating them from one another for reducing the losses resulting from eddy currents. In addition, the priming coat of zinc chromate paint, and the two coats of aluminum paint have been omitted on both of the

cases. It was also noted that the brass screws, used for securing the transformer unit and case cover, are in contact with aluminum. This is contrary to Navy requirements, and steel screws, cadmium plated, should be substituted.

Recommendations

(a) Inasmuch as the subject transformers, having failed to meet the requirements of the specifications in their entirety, it is recommended that their approval for Naval use be withheld until a satisfactory test is performed on sample transformers, modified to overcome the defects noted under "Conclusions" of this report.

(b) Although provisions are made on the terminal blocks for connecting the individual conductors of the line cables, they are not considered to be the best method in view of possible loosening of the connections and short circuits occurring. Therefore, it is recommended that the Bureau consider the advisability of amending the specifications, requiring a standard Bureau of Engineering terminal block, equipped with terminal lugs, Drawing 9-S-1841-L.

DESCRIPTION OF MATERIAL UNDER TEST

4. The subject transformers were manufactured by the Allis Chalmers Company, Pittsburgh, Pa., and rated 100 V.A. and 200 V.A. respectively.
5. They are of the dry type, their cores being made up of separately punched thin steel laminations, insulated from one another with varnish when assembled. Each core supports a primary and secondary winding, insulated from each other and the transformer core, the primary being wound over the secondary.
6. The transformer cores are clamped with two flat wire frames, each bolted to a terminal block of phenolic material with two #10-32 round head brass machine screws, used as through bolts. Secured at each end of the terminal block is an iron angle tapped for a 1/4"-20 brass screw which secures the core assembly to the case. These screws do not thread into the case, but into clearance holes where bosses are provided.
7. The primary and secondary lead wires are equipped with soldered lugs secured to a terminal block with #10-32 round head brass screws equipped with brass washers, steel lockwashers and brass nuts. Stamped into the terminal block is the lettering H1, H2, and X1, X2 which identifies the primary and secondary windings.
8. Each transformer is located in a cast aluminum alloy case made watertight with the use of a 1/4 inch square rubber gasket, partly recessed into the open end of the case, and a "V" edge located on the cover. The cover is secured with six (6) #10-32 round head brass machine screws equipped with brass washers, steel lockwashers and brass nuts, and used as through bolts. Two brackets, cast integral with the case, having holes in each end to accommodate 3/8 inch bolts for mounting, are provided.
9. Each transformer case is provided with three bosses, two tapped for 3/8 inch and one for 3/4 inch (IPS) to accommodate standard terminal tubes.
10. Raised lettering on the outside of the case, below the 3/4 inch boss, reads "X2 - 18.9 V - X1" while that under the 3/8 inch bosses, reads "H2 - 115 V - H1".
11. Located on the outside of each case is a nameplate of corrosion-resisting steel, giving the manufacturer's name, KVA, type, cycles, voltage, and serial number.
12. The cases are finished on the inside with a black insulating varnish and with a dark gray oil paint on the outside.

13. Further information in regards to details and design of the transformers is given by Plates 1 and 2.

METHOD OF TEST

14. Each transformer was first tested for voltage regulation by comparing the secondary voltage at full rated load with the no load voltage when a constant potential of 115 volts, A.C., 60 cycles was applied to the primary. During this test, the efficiency of the transformers was also determined when operated at full rated load and normal primary voltage.

15. Next, the temperature rise of the windings was obtained, using the resistance method, by placing each transformer in a compartment, having an ambient temperature of 40° C (104° F), and operating it for three continuous hours at rated load at a primary voltage of 120 volts.

16. They were next given a short circuit test by shorting the secondaries for a period of 15 seconds at a primary voltage of 120 volts, A.C., 60 cycles.

17. Prior to, and following, the required dielectric tests, the insulation resistance between the windings and the core of each transformer was measured, using a 1000 volt megger.

18. Then followed tests for dielectric strength, to determine whether any damage had occurred to the windings during the period of the temperature rise and short circuit tests.

19. The shock integrity of the transformers was next determined by placing them on a Bureau of Engineering shock stand and applying shocks of 250 foot pounds. During this test, the transformers were mounted on the bulkhead, six inches below point of impact.

20. The usual inspection test on the transformers for conformance with the specifications, relative to materials, design and workmanship, and a test for watertight integrity, concluded the test.

RESULTS OF TEST

21. The test results obtained, follow:

<u>Requirements</u>	<u>Test Values</u>	
	<u>100 V.A.</u>	<u>200 V.A.</u>
Primary voltage: 115 volts	115 volts	115 volts
Secondary voltage: Shall not exceed 20 volts with 115 volts applied to primary.	18.6 volts (No Load)	18.6 volts (No Load)
Frequency and phase: 60 cycles, single phase.	60 cycles, single phase.	60 cycles, single phase.
Voltage regulation: With 115 volt primary, secondary shall be 18 volts at rated load, 100% P.F.	*17.6 volts	*17.2 volts
Efficiency: Shall be not less than 85% at rated load.	85.5%	85.03%
Temperature rise: Shall not exceed 50° C. at ambient temperature of 40° C. at rated load.	Pri.-16.43° C Sec.-15.33° C (Full load, 120 volt primary)	Pri.-21.68° C Sec.-17.02° C (Full load, 120 volt primary)
Rating: Shall be capable of operating continuously at input of 120 volts, full load, without exceeding a temperature rise of 50° C.	Both transformers operated for 3 hours, full load, at ambient temperature of 40° C. Temperature rises as given.	
Short circuit test: With short across secondary for 15 seconds, at primary of 120 volts, no injury shall occur to the transformer.	Satisfactory	Satisfactory
Insulation resistance: Not specified. Primary to core, secondary to core, and between windings following the short circuit test.	200 megohms (By 1000 V. megger)	200 megohms (By 1000 V. megger)
Dielectric strength: Shall withstand 2500 V. A.C., 60 cycles, for 1 min. between primary and core with secondary grounded to core, and 1250 V. A.C., 60 cycles, between secondary and core with primary grounded to core.	Satisfactory	Satisfactory

<u>Requirements</u>	<u>Test Values</u>	
	<u>100 V.A.</u>	<u>200 V.A.</u>
Dimensions: Shall not exceed 6 x 12 x 6 inches.	6 x 10.5 x 6"	6 x 10.5 x 6"
Weight: Shall not exceed 15 lbs.	*15 lbs.9 oz.	*19 lbs.1oz.
Painting: Inside of case, one priming coat of zinc chromate paint, plus two coats of varnish. Outside, two coats of battleship gray over same base coats.	*Both cases painted with black insulating varnish on the inside and with oil gray paint on the outside. Zinc chromate and aluminum paints have been omitted.	
Watertightness: Shall not leak when sprayed with a stream of water from a 1" nozzle, under head of 35 feet, from a distance of 10 feet, for a period of 5 min.	Satisfactory	Satisfactory
Shock integrity: Not specified.	*Unsatisfactory, see comments under "Conclusions".	
Transformer mounting: Bosses provided on the inside of case.	*Unsatisfactory, see comments under "Conclusions".	
Nameplates: Specified under par. D-8.	Complied with.	Complied with.
Terminal connections: A terminal block of phenolic material equipped with terminals for both primary and secondary leads and line connections.	*Satisfactory, except that terminal lugs have not been furnished for the line connections.	
Bosses for terminal tubes: Shall be tapped for two size "A" and one size "E" terminal tubes.	Complied with.	Complied with.
Case construction: Specified under par.E-3d(2).	*Both cases satisfactory except provisions for mounting of the transformer unit.	

*Denotes failure to comply with the specifications.

CONCLUSIONS

22. The subject transformers, under test for conformance with the specifications, reference (b), failed to comply with the following requirements.

(a) The secondary voltages of the transformers are 17.6 volts for the 100 V.A., and 17.2 volts for the 200 V.A., at rated loads and 115 volts impressed across each primary. The specifications require a secondary voltage of 18 volts under these conditions.

(b) The total weight of the 100 V.A. transformer is 15 lbs. 9 oz. and 19 lbs. 1 oz. for the 200 V.A. transformer. The maximum allowable weight is 15 lbs.

(c) Although two (2) bosses are provided on the inside of each case for the transformer mounting screws, they are not considered sufficient to insure a stable and rugged mounting for the transformer unit. The brass securing screws extend into holes in the bosses and not into threaded steel inserts, as required by the specifications.

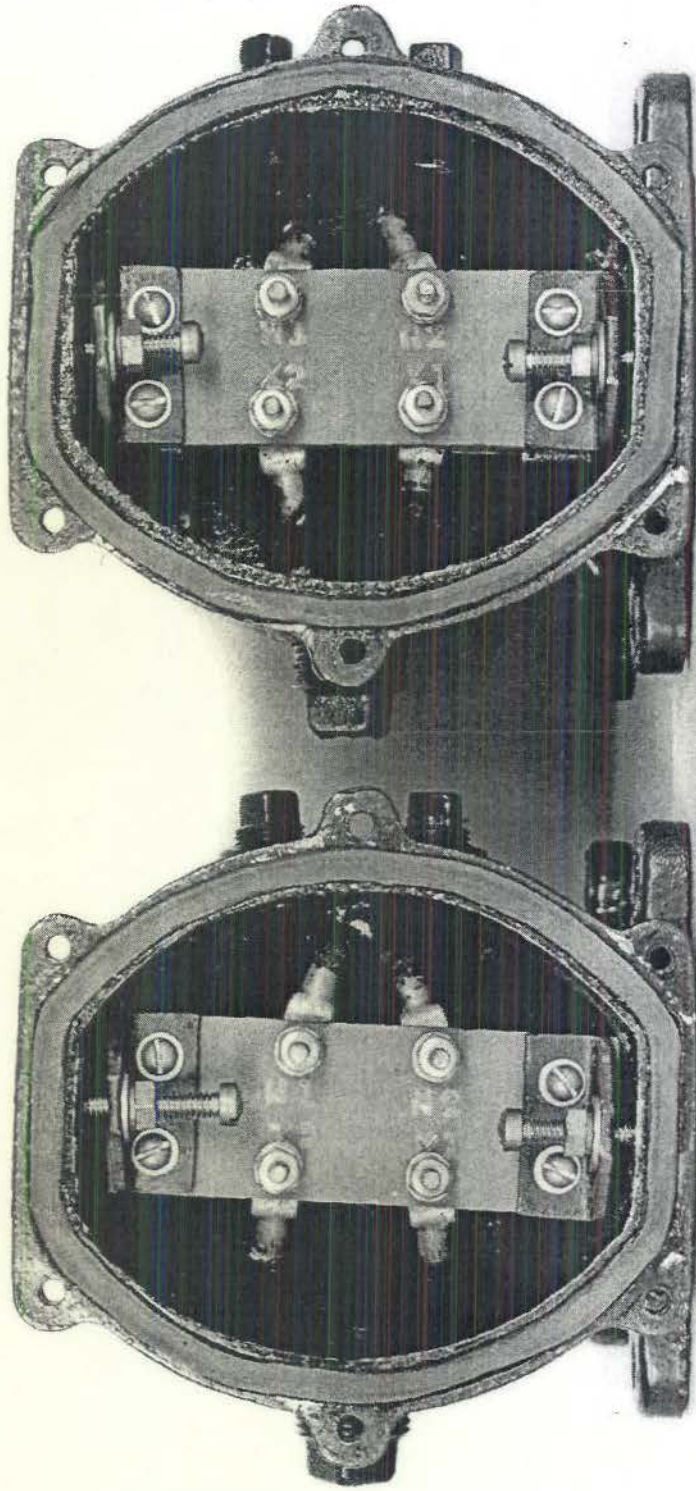
(d) Under test for shock integrity, the transformers when placed on a Bureau of Engineering shock stand in the vertical plane, six inches below point of impact, and given shocks of 250 foot pounds, the brass screws, securing the transformers to the case, partly backed out upon the application of each blow. Had sufficient bosses with threaded steel inserts been provided for the securing screws as required, the transformer units no doubt would have remained stable.

(e) Under inspection of the transformers, relative to materials and workmanship, it was observed that the outer edges of the core laminations of the 200 V.A. unit have been filed or ground in order to fit the transformer into the case. The filing of these laminations defeats the purpose of insulating them from one another for reducing the losses resulting from eddy currents. In addition, the priming coat of zinc chromate paint, and the two coats of aluminum paint have been omitted on both of the cases. It was also noted that the brass screws, used for securing the transformer unit and case cover, are in contact with aluminum. This is contrary to Navy requirements, and steel screws, cadmium plated, should be substituted.



1767

NAVAL RESEARCH LABORATORY
ANACOSTIA STATION
WASHINGTON, D. C.



1768

NAVAL RESEARCH LABORATORY
ANACOSTIA STATION
WASHINGTON, D. C.